DoD High Performance Computing Modernization Program: a Distributed Computing Program

January 2015

www.hpc.mil

Larry Davis

HPC Modernization Program

VISION

A **pervasive culture** existing among DoD's scientists and engineers where they **routinely use advanced computational environments** to solve the most demanding problems transforming the way DoD does business—finding better solutions faster.
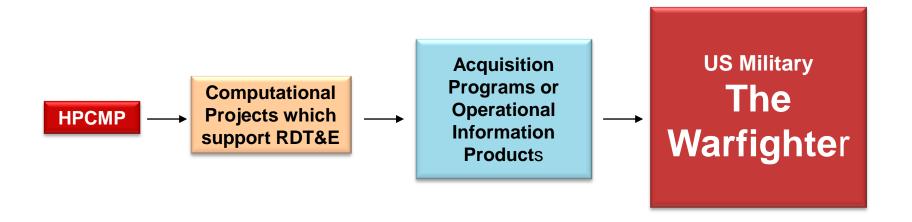
MISSION

Accelerate development and transition of advanced defense technologies into superior warfighting capabilities by exploiting and strengthening US leadership in supercomputing, communications, and computational modeling.

Technology Transition to the Warfighter

HPCMP Simplified Value Chain

HPCMP → **Computational Projects which support RDT&E** → **Acquisition Programs or Operational Information Products** → **US Military The Warfighter**

5 Execution Priorities

- **Maintain Leadership**
  - Continue to effectively deliver high performance computing capabilities to the RDT&E community
  - Pursue new service delivery models that better align the services with unique customer requirements
  - Assume a leadership role in green high performance computing

- **Expand the Base**
  - Expand the application of HPC into emerging and non-traditional DoD mission areas
    - Acquisition/engineering communities, cyber, medicine, big data….

- **Increase Customer Productivity**
  - Provide portal tools that will support the seamless execution of workflows, make HPC services easily consumable by the next-generation workforce, and address the security barriers associated with connecting distributed desktops to centralized resources
  - Keep pace with available cloud services

5 Execution Priorities *(continued)*

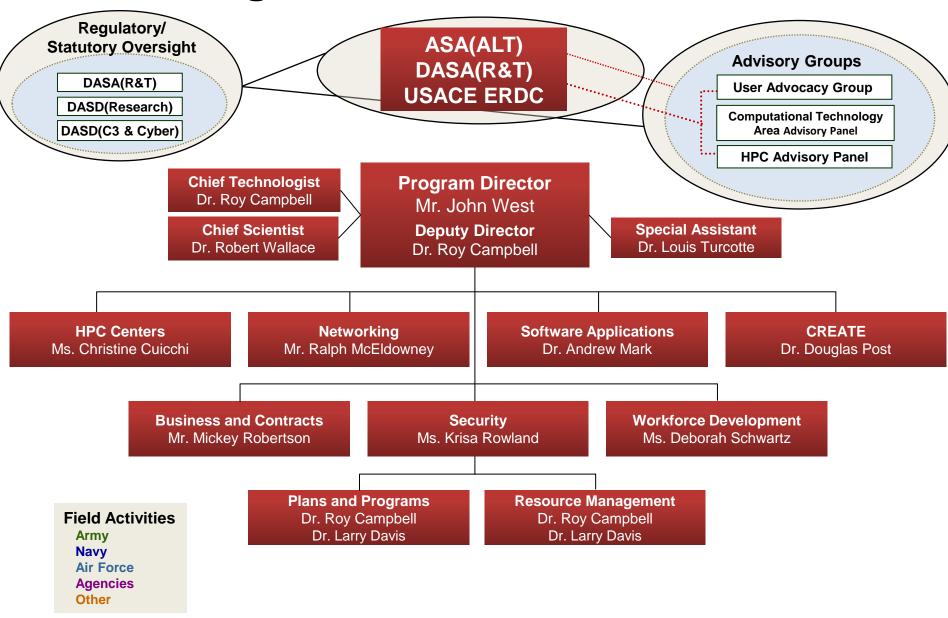- ## Exploit Next-Generation Technologies
  - Anticipate and exploit next-generation HPC technologies
    - Involvement in exascale initiatives, research investments in future HPC capabilities
    - Development of a software investment strategy that will position the DoD to efficiently consume future computing and communications capabilities

- ## Develop the Workforce
  - Develop and provide materials and experiences that create both a computationally literate technical workforce for the DoD and a cadre of computational professionals to provision HPC services
    - Investments in STEM programs, support for internships, and involvement in national initiatives that attract and engage with the next-generation workforce

HPCMP Organization Chart

Regulatory/ Statutory Oversight
- DASA(R&T)
- DASD(Research)
- DASD(C3 & Cyber)

ASA(ALT) DASA(R&T) USACE ERDC

Advisory Groups
- User Advocacy Group
- Computational Technology Area Advisory Panel
- HPC Advisory Panel

Chief Technologist
Dr. Roy Campbell

Chief Scientist
Dr. Robert Wallace

Program Director
Mr. John West
Deputy Director
Dr. Roy Campbell

Special Assistant
Dr. Louis Turcotte

HPC Centers
Ms. Christine Cuicchi

Networking
Mr. Ralph McEldowney

Software Applications
Dr. Andrew Mark

CREATE
Dr. Douglas Post

Business and Contracts
Mr. Mickey Robertson

Security
Ms. Krisa Rowland

Workforce Development
Ms. Deborah Schwartz

Plans and Programs
Dr. Roy Campbell
Dr. Larry Davis

Resource Management
Dr. Roy Campbell
Dr. Larry Davis

Field Activities
- **Army**
- **Navy**
- **Air Force**
- **Agencies**
- **Other**

Service/Agency Approval Authorities (S/AAAs)

- **Allocate Service/Agency controlled CPU hours on HPCMP systems**

- **Provide coordination with customer organizations, the HPCMP, and other S/AAAs**

- **Ensure Project Leaders and authorized users are performing work in support of DoD**

- **Implement requirements surveys, resource allocation, resource monitoring and resource reallocation**

- **Provide guidance to users on which HPC assets are appropriate for their projects**

- **Trade allocations with other S/AAAs**

HPCMP Provides a Complete Set of Integrated Advanced Computing Capabilities

- **Developing next-generation scientific and engineering software for advanced computing**
  - Fostering similar development by other DoD organizations

- **Advanced computing capabilities via five Centers and an integrated network**
  - *Efficiently*: Costs are 2–5 times less expensive than commercial cloud solutions for similar capability
  - *Effectively*: HPCMP resource utilization averages approximately 90% of available capacity

- **Fostering the development of a computational workforce**

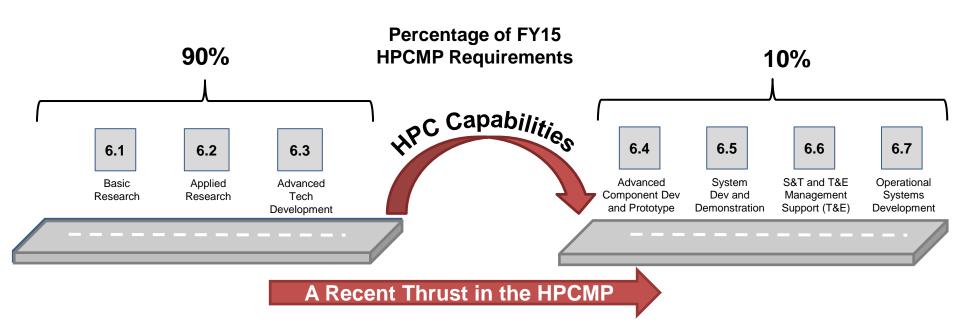- **Integrating these capabilities to solve complex DoD problems**

What the HPCMP Offers Currently

- **Approximately a dozen large HPC systems from a variety of vendors at five DoD Supercomputing Resource Centers**

- **Connectivity to these centers via a capable wide-area network – the Defense Research and Engineering Network**

- **Expert help in all aspects of setting up accounts and using HPC systems through the Consolidated Customer Assistance Center and the User Productivity Enhancement, Technology Transfer and Training program**

- **Access to many commercial applications software packages for analysis**

- **Access to CREATE design modeling tools as they are developed**

All members of the DoD RDT&E community are eligible to access and use these capabilities at no cost to the end user

Percentage of Total FY15 Requirements by Budget Area

90%

Percentage of FY15 HPCMP Requirements

10%

6.1	6.2	6.3
Basic Research	Applied Research	Advanced Tech Development

HPC Capabilities

6.4	6.5	6.6	6.7
Advanced Component Dev and Prototype	System Dev and Demonstration	S&T and T&E Management Support (T&E)	Operational Systems Development

A Recent Thrust in the HPCMP
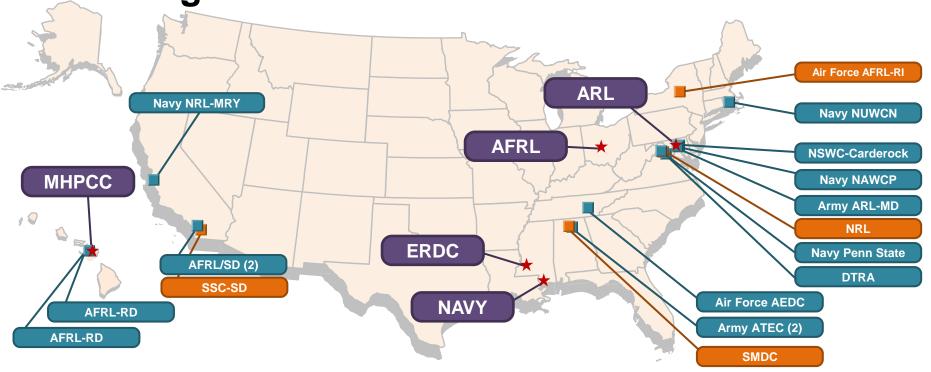
Computational Technology Areas (CTAs)*

Computational Technology Area	Leads	DOD Projects	
		Primary	Not Primary
Computational Structural Mechanics (CSM)	Carl Dyka, NSWCD	88	180
Computational Fluid Dynamics (CFD)	Roger Strawn, AMRDEC	226	295
Computational Chemistry, Biology, and Materials Science (CCM)	William Mattson, ARL	101	134
Computational Electromagnetics and Acoustics (CEA)	Andrew Greenwood, AFRL	49	88
Climate/Weather/Ocean Modeling and Simulation (CWO)	William Burnett, NAVO	39	51
Signal/Image Processing (SIP)	Paul Antonik, AFRL	23	57
Forces Modeling and Simulation (FMS)	Jennifer Park, SPAWAR	15	39
Environmental Quality Modeling and Simulation (EQM)	David Richards, ERDC	2	11
Electronics, Networking, and Systems (ENS)/C4I	VACANT	14	29
Integrated Modeling and Test Environments (IMT)	VACANT	14	30
Space and Astrophysical Sciences (SAS)	Jill Dahlburg, NRL	8	19
Other		16	26
Grand Total		**595**	**959**

* FY 2015 requirements survey

HPCMP Supercomputing Resources
Delivering HPC to the User

DOD Supercomputing Resource Centers (DSRC)	• US Air Force Research Lab (AFRL) • Maui HPC Center (MHPCC) • US Army Engineer Research and Development Center (ERDC)	• US Army Research Lab (ARL) • NAVY

Affiliated Resource Centers (ARC)	• US Air Force Research Lab, Information Directorate, AFRL-RI • US Army, Space and Missile Defense Command SMDC	• Naval Research Lab (NRL) • US Navy, SSC-SD

Dedicated HPC Project Investments (DHPI) FY11/12/13	• US Navy, Penn State • US Army, ATEC (2) ⚲ US Air Force, AEDC • US Air Force, AFRL/RD	• US Air Force, AFRL/SD (2) • US Army, ARL-MD • US Navy, NSWC-Carderock • US Navy, NUWCN	• DTRA ⚲ US Navy, NRL-MRY ⚲ US Navy, NAWCP

Distribution Statement C Applies, see cover page for specifics

Five Centers
Roles and Responsibilities

ARL
- Classified Computing Services
- Unclassified, but Sensitive, Computing Services
- CDAAC
- CDR

AFRL
- Unclassified, but Sensitive, Computing Services
- HPC Helpdesk
- SW Configuration Management
- IAM Panel Lead
- ESM/ECM

ERDC
- Unclassified, but Sensitive Computing Services
- Open Research Computing Services
- UDAAC
- UIT/ezHPC and pIE
- WMS

NAVY
- Unclassified, but Sensitive, Computing Services
- Classified Computing Services
- UDR
- 24x7 Oceanographic Operations Modeling

MHPCC
- Unclassified, but Sensitive, Computing Services
- Special Computing Services
- UIT Client Development
- Portal Development

Strength Through Shared Services & Leadership

DOD Supercomputing Resource Centers (DSRCs)
Current Capability

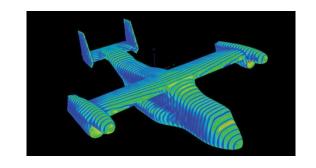| Location	System	Available Processors (Cores and Accelerators)	Memory (GB)	Peak Performance (TeraFLOPS)
AFRL	**SGI ICE X**	73,440	146,880	1,528
	SGI UV	1,004	3,514	22
	Cray XC30	56,880+(32 GPU)	153,088	1281
	SGI ICE X	125,888+(356 Phi)+(356 GPU)	453.136	5620
ARL	**Cray XT5 (Classified)**	15,600	41,600	100
	IBM iDataPlex	20,160	45,696	419
	IBM iDataPlex (Classified)	17,472	69,888	363
	Cray XC40	101,312+(32 GPU)	405,248	3774
ERDC	**Cray XE6**	150,912	301,824	1509
	Cray XE6 (Open Research)	14,976	29,952	138
	SGI ICE X	125,440+(32 GPU)	443,584	4662
MHPCC	**IBM iDataPlex**	12,096	24,192	253
NAVY	**IBM iDataPlex (Classified)**	4,032	8,960	84
	IBM iDataPlex	19,520	40,064	407
	IBM iDataPlex	19,520	40,064	407
	Cray XC30	29,352+(124 Phi)	82,752	786
	Cray XC30	28,584+(124 Phi)+(32 GPU)	82,112	822
	Cray XC40	50,208+(168 Phi)	200,000	1982
	Cray XC40	50,208+(168 Phi)	200,000	1982
	Cray XC40 (Classified)	6,720+(24 Phi)	27,109	266
	Total	**923,324**	**2,346,980**	**26,405**

FY15 HPC Systems shown in PURPLE (TI-15 systems operational in Q4 FY15)
FY15 HPC Systems shown in GREEN (TI-14 systems operational in Q3 FY15)
FY14 HPC Systems shown in LIGHT BLUE
FY13 HPC Systems shown in ORANGE
FY11 HPC Systems shown in BLUE (TI-11/12 HPC systems operational in FY12)
FY09 HPC Systems shown in RED

As of: December 2014

Distribution Statement C Applies, see cover page for specifics

HPC Centers' Technical Services Support

- **Technical Services**
  - Customer Assistance and Support
  - System and Network Administration
  - System Installation and Integration
  - Application/System Performance Analysis
  - Data Analysis and Assessment
    - Classified and unclassified capability
  - Operators and Operations Support
    - Enterprise System Monitoring (ESM)
  - Outreach

Consolidated Customer Assistance Center (CCAC)

- **First point-of-contact for HPCMP user**

- **Telephone, user-portal, and email support**

- **Single ticket tracking system across all sites**

- **Tier 0 – Self Help/Knowledge Management System on CCAC User Portal**

- **Tier 1 and some Tier 2 support - CCAC**

- **Tier 2 support - Centers**

- **Tier 3 support - OEMs, PETTT, & Centers**

- **11,883 tickets processed in FY14**

User

Ticketing System

CCAC
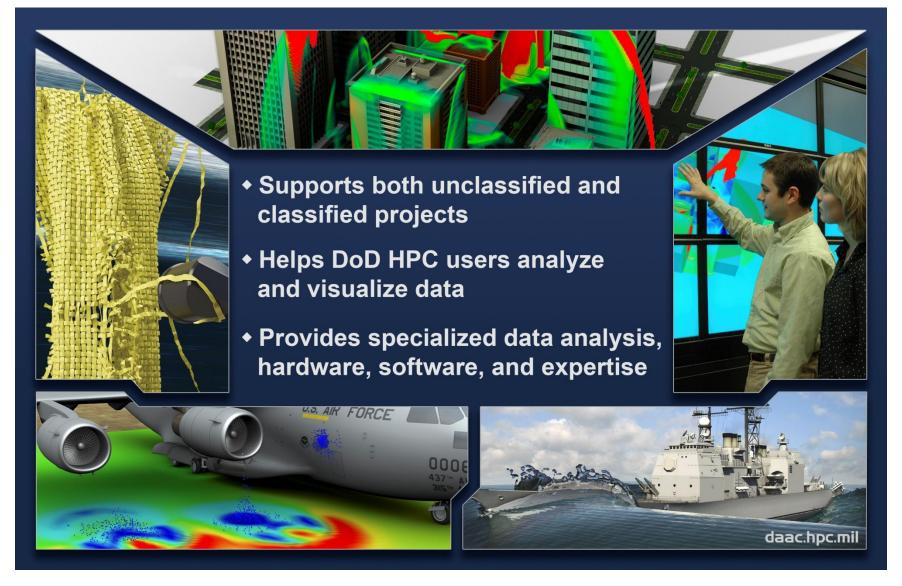- Help Desk (Tier 1)
- Tier 2

CCAC Liaisons @ Centers
- Tiers 2
- Vendors 3

Data Analysis and Assessment Center

- Supports both unclassified and classified projects

- Helps DoD HPC users analyze and visualize data

- Provides specialized data analysis, hardware, software, and expertise

daac.hpc.mil

Baseline Configuration

Operating Policies to Make System Diversity User Friendly

Common Software Environment:
Open-Source Libraries, Utilities &Compilers, Editors, Scripting Tools, Environment Variables, Debuggers, Login Shells, Multi-version SW Modules

Standardized Processes:
*Queue Names,
User Notices,
Security Access*

User Support Features:
*Cross-Center File Transfer,
Sample Code Repository,
Ticket Life Consistency*

DOD Supercomputing Resource Centers
Highlighted Projects/Services

- **User Dashboard**
  - Web display of user-specific metrics and real-time system information

- **Software Configuration Management**
  - Sharing software licenses across multiple Centers

- **HPC Portal**
  - Desktop access to HPC

- **Advance Reservation Service**
  - Reserve CPUs for a specific start time

- **Dedicated Support Partition**
  - Dedicated CPUs for an extended period

- **Storage Management**
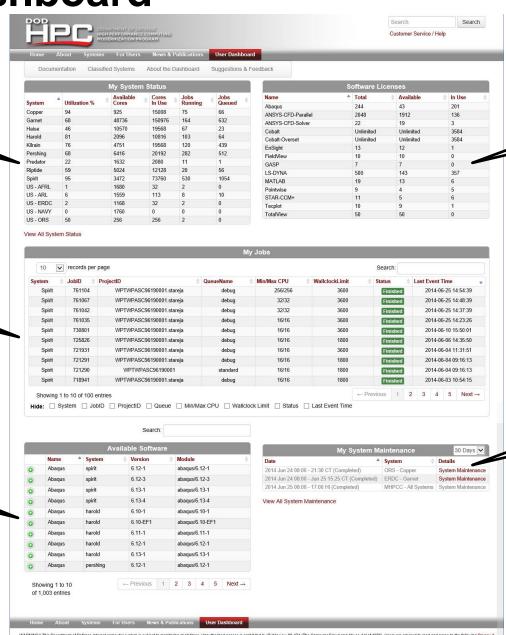 - Data management for the customer
  - Data Recovery

User Dashboard

DOD HPC — DEPARTMENT OF DEFENSE HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

Search [Search]

Customer Service / Help

Home | About | Systems | For Users | News & Publications | **User Dashboard**

Documentation | Classified Systems | About the Dashboard | Suggestions & Feedback

System Status

My System Status

System	Utilization %	Available Cores	Cores In Use	Jobs Running	Jobs Queued
Copper	94	925	15008	75	66
Garnet	68	48736	150976	164	632
Haise	46	10570	19568	67	23
Harold	81	2096	10816	103	64
Kilrain	76	4751	19568	120	439
Pershing	68	6416	20192	282	512
Predator	22	1632	2080	11	1
Riptide	59	5024	12128	20	56
Spirit	95	3472	73760	530	1054
US - AFRL	1	1680	32	2	0
US - ARL	6	1559	113	8	10
US - ERDC	2	1168	32	2	0
US - NAVY	0	1760	0	0	0
US - ORS	50	256	256	2	0

View All System Status

Software Licenses

Software Licenses

Name	Total	Available	In Use
Abaqus	244	43	201
ANSYS-CFD-Parallel	2048	1912	136
ANSYS-CFD-Solver	22	19	3
Cobalt	Unlimited	Unlimited	3584
Cobalt-Overset	Unlimited	Unlimited	3584
EnSight	13	12	1
FieldView	10	10	0
GASP	7	7	0
LS-DYNA	500	143	357
MATLAB	19	13	6
Pointwise	9	4	5
STAR-CCM+	11	5	6
Tecplot	10	9	1
TotalView	50	50	0

Job Status & History

My Jobs

10 records per page   Search: [   ]

System	JobID	ProjectID	QueueName	Min/Max CPU	WallclockLimit	Status	Last Event Time
Spirit	761104	WPTWPASC96190001.stareja	debug	256/256	3600	Finished	2014-06-25 14:54:39
Spirit	761067	WPTWPASC96190001.stareja	debug	32/32	3600	Finished	2014-06-25 14:48:39
Spirit	761042	WPTWPASC96190001.stareja	debug	32/32	3600	Finished	2014-06-25 14:37:39
Spirit	761035	WPTWPASC96190001.stareja	debug	16/16	3600	Finished	2014-06-25 14:23:26
Spirit	730801	WPTWPASC96190001.stareja	debug	16/16	3600	Finished	2014-06-10 15:50:01
Spirit	725826	WPTWPASC96190001.stareja	debug	16/16	1800	Finished	2014-06-06 14:35:50
Spirit	721931	WPTWPASC96190001.stareja	debug	16/16	3600	Finished	2014-06-04 11:31:51
Spirit	721291	WPTWPASC96190001.stareja	debug	16/16	1800	Finished	2014-06-04 09:16:13
Spirit	721290	WPTWPASC96190001	standard	16/16	1800	Finished	2014-06-04 09:16:13
Spirit	718941	WPTWPASC96190001.stareja	debug	16/16	1800	Finished	2014-06-03 10:54:15

Showing 1 to 10 of 100 entries   ← Previous 1 2 3 4 5 Next →

Hide: ☐ System ☐ JobID ☐ ProjectID ☐ Queue ☐ Min/Max CPU ☐ Wallclock Limit ☐ Status ☐ Last Event Time

Available Software

Search: [   ]

Available Software

	Name	System	Version	Module
⊕	Abaqus	spirit	6.12-1	abaqus/6.12-1
⊕	Abaqus	spirit	6.12-3	abaqus/6.12-3
⊕	Abaqus	spirit	6.13-1	abaqus/6.13-1
⊕	Abaqus	spirit	6.13-4	abaqus/6.13-4
⊕	Abaqus	harold	6.10-1	abaqus/6.10-1
⊕	Abaqus	harold	6.10-EF1	abaqus/6.10-EF1
⊕	Abaqus	harold	6.11-1	abaqus/6.11-1
⊕	Abaqus	harold	6.12-1	abaqus/6.12-1
⊕	Abaqus	harold	6.13-1	abaqus/6.13-1
⊕	Abaqus	pershing	6.12-1	abaqus/6.12-1

Showing 1 to 10 of 1,003 entries   ← Previous 1 2 3 4 5 Next →

System Maintenance

My System Maintenance   [30 Days ▾]

Date	System	Details
2014 Jun 24 08:00 - 21:30 CT (Completed)	ORS - Copper	System Maintenance
2014 Jun 24 08:00 - Jun 25 15:25 CT (Completed)	ERDC - Garnet	System Maintenance
2014 Jun 25 08:00 - 17:00 HI (Completed)	MHPCC - All Systems	System Maintenance

View All System Maintenance

Home | About | Systems | For Users | News & Publications | **User Dashboard**

MB Revised: 7/1/2014

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Software Configuration Management
Sharing Licenses Across the Enterprise

Package	Baseline as of January 2015
Abaqus	Analysis tokens: 244 & add-ons; 26 & add-ons (classified) ;
Accelrys	Site licenses: MS_COMPASS, MS_DISCOVER, MS_DMOL3-SOLID-STATE, MS_CASTEP_PARALLEL; Flexible tokens: 8; MS_VISUALIZER 8;
ANSYS	Negotiated WAN model: 23 CFD Solvers, 2048 CFD HPC, 5 Gambit (locked to geographic pools); 1 CFD Solver, 192 CFD HPC (classified)
CFD++	2 Site licenses: ARL, AFRL; Floating: 2 Serial + 60 Parallel; Add on Modules: EDP & TNE
Cobalt	Site licensed at all sites – Currently in procurement process
EnSight Suite	13 Standard, 10 Gold, 5 EnLiten Gold, 2 DR 6 Standard, 2 DR (classified)
GASP	7 (unlimited cores per job)
Gaussian Suite	3 site licenses: 1 ARL, 1 AFRL, 1 ERDC
LS-DYNA & 3D	500
MATLAB	21 (3 Classified), 64 Dist Comp Toolbox, 10 Parallel Comp Toolbox
Star-CD, Star-CCM+	11 Power Session licenses (unlimited cores per job)
TotalView	50 architecture-free
DDT	8,260 maximum processes
FieldView	10 Utility Servers, 5 Standard and 5 batch AFRL
Pointwise	5 Utility Servers, 4 AFRL. 4 ARL
Tecplot	10 Utility Servers, 9 AFRL, 8 ARL
Utility Server Software	
INTEL	5 Cluster Toolkit seats

ARL DSRC

AFRL DSRC

NAVY DSRC

MHPCC DSRC

ERDC DSRC

Distribution Statement C Applies, see cover page for specifics

HPC Portal – Web Supercomputing

Quick Access to HPC
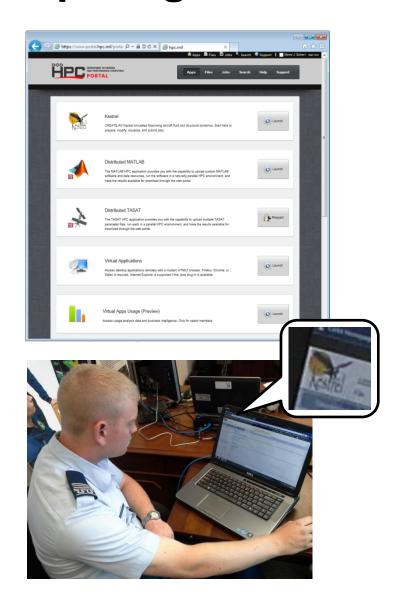
– **Easy to Use**
  - Similar to a webmail interface
  - No user-installed software or patches
  - Integrated videos, forums, and help

– **Secure**
  - Quick DOD CAC-authentication
  - Secured at one server vs. many desktops
  - YubiKey enabled for University and Industry collaborators
  - No desktop install is a security best-practice
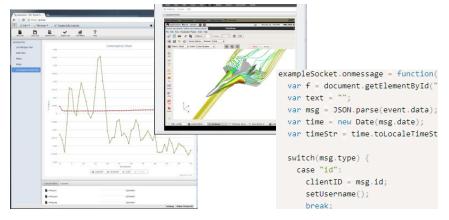
– **Powerful**
  - Access to more than 50,000 CPU Cores
  - Power-user command-line shell access
  - Many apps at one location
  - Software runs close to large datasets

HPC Portal Benefits

Applications for DOD-Scale Solutions

- **HPC applications**
  - CREATE software
  - Domain-specific tools
  - General analysis and visualization
  - Software Developer Kit to build ecosystem

Productivity via Workflows

Integrated analysis and engineering

Collaboration and Learning
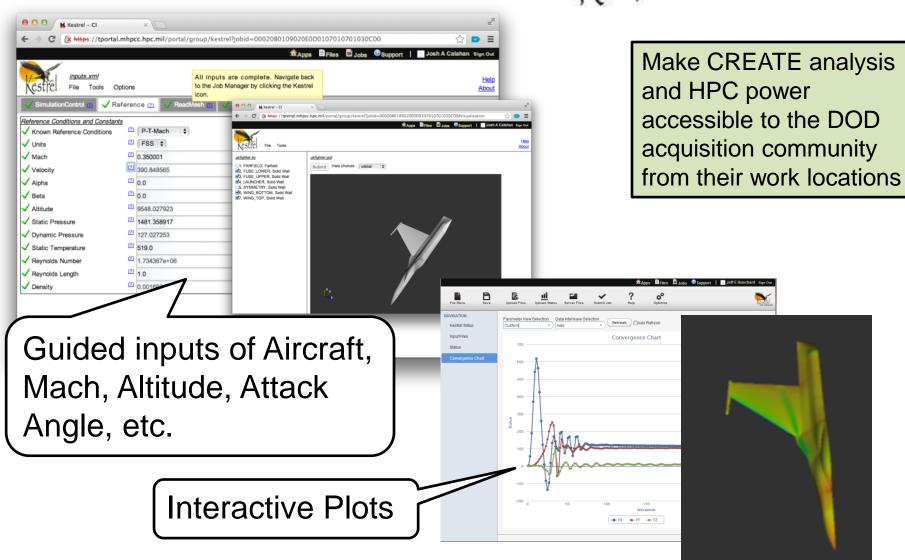
Apply the power of supercomputing to impact the mission!

HPCMP CREATE™ Kestrel
Delivery Using the HPC Portal
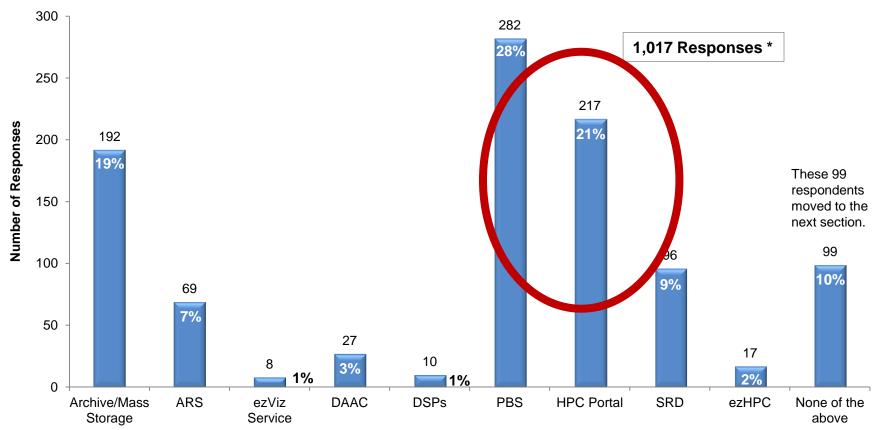
Make CREATE analysis and HPC power accessible to the DOD acquisition community from their work locations

Guided inputs of Aircraft, Mach, Altitude, Attack Angle, etc.

Interactive Plots

User Satisfaction Survey FY14
Services, Tools and Capabilities

Have you used/taken advantage of any of the following Program services, tools and/or capabilities? (choose all that apply*)

1,017 Responses *

Category	Responses	Percent
Archive/Mass Storage	192	19%
ARS	69	7%
ezViz Service	8	1%
DAAC	27	3%
DSPs	10	1%
PBS	282	28%
HPC Portal	217	21%
SRD	96	9%
ezHPC	17	2%
None of the above	99	10%

These 99 respondents moved to the next section.
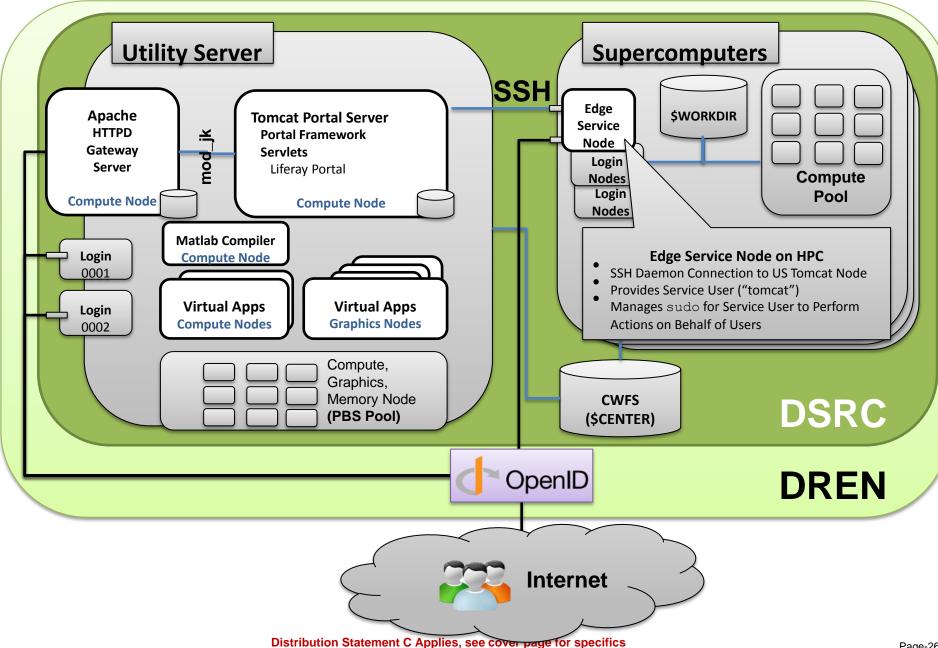
If only S/AAA role selected, respondent skipped this section.

 * Allowed for doubled counting.

Portal Architecture

Utility Server

Apache
HTTPD
Gateway
Server

Compute Node

mod_jk

Tomcat Portal Server
Portal Framework
Servlets
  Liferay Portal

Compute Node

Matlab Compiler
Compute Node

Login 0001

Login 0002

Virtual Apps
Compute Nodes

Virtual Apps
Graphics Nodes

Compute,
Graphics,
Memory Node
(PBS Pool)

SSH

Supercomputers

$WORKDIR

Edge Service Node
Login Nodes
Login Nodes

Compute Pool

Edge Service Node on HPC
- SSH Daemon Connection to US Tomcat Node
- Provides Service User ("tomcat")
- Manages sudo for Service User to Perform Actions on Behalf of Users

CWFS
($CENTER)

DSRC

OpenID

DREN

Internet

Advance Reservation Service (https://reservation.hpc.mil/)

- **Advance Reservation Service (ARS) capability is available on all production systems**

- **ARS allows a user to reserve a block of time for their use on any system for which the user has an account**

- **A reservation can be made up to 24-hours in advance of the requested time slot for up to 8 wall-clock hours of usage**

- **A reservation can be made up to 3 months in advance for a block of up to 168 wall-clock hours**

- **A single user can reserve up to 50% of ARS resources available on a system**

  - Typically, 25% of a system is available for ARS

Dedicated Support Partition (DSP)

- **Intended to support large computational work that would benefit from a dedicated system partition and not be addressable with advance reservation service or utility server**
  - Long-term recurring work (30–360 days)
  - Developmental testing

- **AFRL DSRC**
  - 57K Xeon Ivy Bridge Cray Cluster, 2 DSPs, partition sizes 512 and 5000 cores
  - 73K Xeon Sandy Bridge SGI Cluster, 1 DSP, partition size 1088 cores

- **ARL DSRC**
  - 20K Xeon Sandy Bridge IBM Cluster, 1 DSP, partition size 1040 cores
  - 17K Xeon Sandy Bridge IBM Cluster, 1 DSP, partition size 1088 cores

- **ERDC DSRC**
  - 150K AMD Interlagos Cray Cluster, 1 DSP, partition size 1184 cores
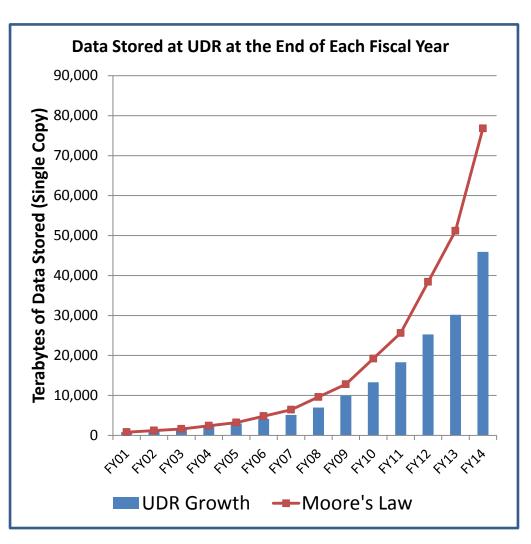
- **MHPCC DSRC**
  - 12K Xeon Sandy Bridge IBM Cluster
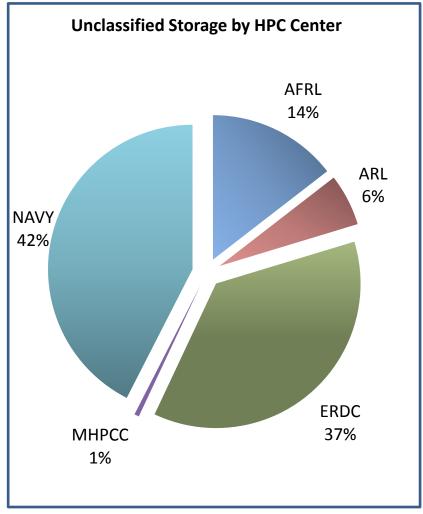 - 6 DSPs, with partition sizes ranging from 32 cores to 1024 cores

- **Navy DSRC**
  - 19K Xeon Sandy Bridge IBM Cluster, 1 DSP, partition size 1024 cores

Long-Term Data Storage

Data Stored at UDR at the End of Each Fiscal Year

Terabytes of Data Stored (Single Copy)

Legend: UDR Growth, Moore's Law

Unclassified Storage by HPC Center

- AFRL 14%
- ARL 6%
- ERDC 37%
- MHPCC 1%
- NAVY 42%

Dedicated HPC Project Investments (DHPIs)

Dedicated HPC Project Investments (DHPIs) are modest-sized HPC systems awarded to technically-sound, mission-critical projects that <u>cannot be performed with shared HPCMP resources</u> due to classification level, special operational requirements (e.g., real-time turnaround) and/or use of emerging technologies

Awarded DHPI Proposals FY14 ($4.1M)

Real-Time Hadoop/Hbase High Performance Computing System ($0.35M)
Army/ATEC, WSMR, NM and Aberdeen Test Center, MD

Applications of the Digital Thread to Capability Planning & Analysis ($2.25M)
Air Force/AF Lifecycle Management Center, Wright-Patterson AFB, OH

On-Demand GPU Applications ($1.5M)
Navy/Naval Research Laboratory, DC

**9 proposals received: 3 selected, 1 recommended for DSRC support
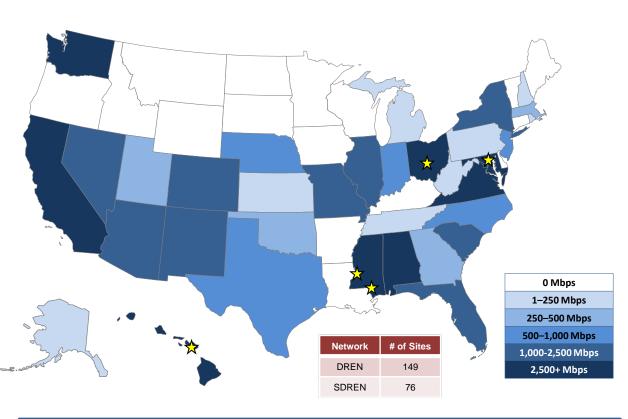TI BOA available for system acquisition, or obligate by 30 Sept**
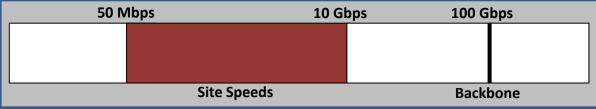
Networking

Defense Research & Engineering Network (DREN)

- **DoD's premier RDT&E network – focused on S&T and T&E – provides separation from Warfighting networks**

- **High-bandwidth, low-latency, full-service network**

- **Connects DoD Supercomputing Resource Centers (DSRCs) and users**

- **Secret-level network overlay on DREN backbone (SDREN)**

- **DREN III provides 50 Mbps to 10 Gbps service to DoD sites; across a 100 Gbps backbone**

- **Fully supports IPv6 & Multicast**

- **Enables research and test events requiring low-jitter, low-latency and high-throughput**

- **One component of the Global Information Grid – Sister network to NIPRNet/SIPRNet**

0 Mbps	
1–250 Mbps	
250–500 Mbps	
500–1,000 Mbps	
1,000–2,500 Mbps	
2,500+ Mbps	

Network	# of Sites
DREN	149
SDREN	76

50 Mbps	10 Gbps	100 Gbps
Site Speeds		Backbone

DREN III Highlights

- **DREN III contract successfully awarded in late 2012**

  - CenturyLink received a 10 year IDIQ award, worth up to $750M

  - New technical capabilities such as Ethernet and Optical Services

  - Significantly increased capability

Attribute	DREN II	DREN III	Ratio
Backbone *(in Gbps)*	10	100	~10
Aggregate On-ramp BW *(in Gbps)*	30	150	~5
Internet BW *(in Gbps)*	4	20	~5

- **Transition of 149 sites completed by 17June 2014**

Resource Management
Requirements & Allocations

- **Mission**
  - To ensure HPCMP computational resources are appropriately distributed across the DOD RDT&E communities based upon documented requirements and Service priorities

- **Goals**
  - Gather, analyze, store, and report requirements, allocation and usage information on DOD computational projects and HPC systems performance to support DOD/Services/Agencies allocation, program planning, acquisition, and operational processes
  - Execute and report customer community special interest activities, such as requirements site visits and Challenge and Frontier Project allocation processes

Requirements

Requirements Gathering and Site Visits

pIE
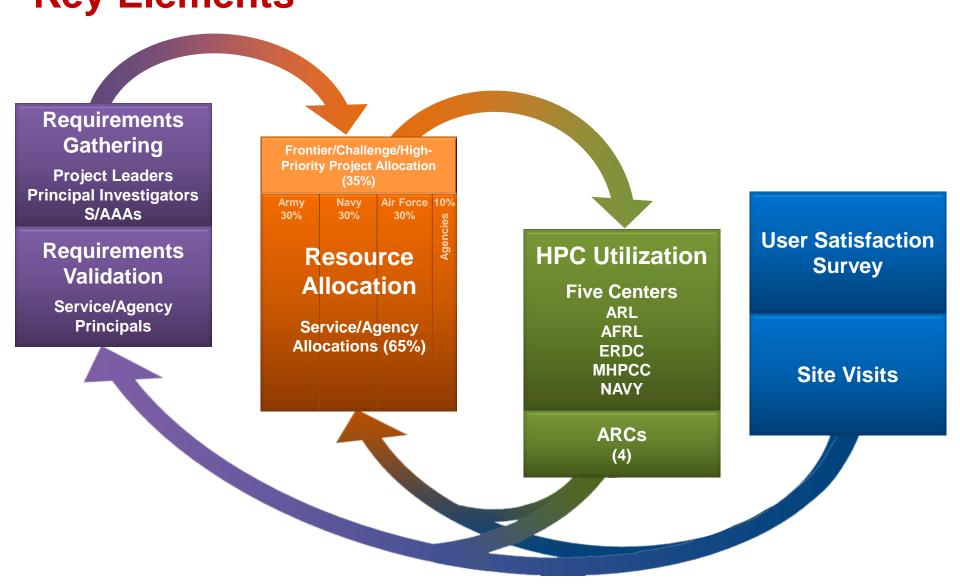
Portal to the Information Environment

Allocations

Challenge Projects, Frontier Projects, Capability Applications Projects (CAPs)

Metrics

HPC Systems Performance

Not yet approved for public release

HPCMP Resource Management Process
Key Elements

Requirements Gathering

Project Leaders
Principal Investigators
S/AAAs

Requirements Validation

Service/Agency
Principals

Frontier/Challenge/High-Priority Project Allocation (35%)

Army 30%	Navy 30%	Air Force 30%	10% Agencies

Resource Allocation

Service/Agency
Allocations (65%)

HPC Utilization

Five Centers
ARL
AFRL
ERDC
MHPCC
NAVY

ARCs
(4)

User Satisfaction Survey

Site Visits

The Information Environment (IE)
(and Its Portal (pIE))

- **Authoritative database for all user, project, and subproject information**

- **All accounts must be approved by the Service organization's Service/Agency Approval Authority (S/AAA)**

- **Requirements questionnaire incorporated into IE**

- **All training requirements part of IE**
  - Information Assurance tracked now
  - Additional training will be tracked with January release

- **Constantly evolving to accommodate new Program initiatives**
  - International Access forms
  - Unix Groups
  - New Software Request Forms
  - Dedicated Support Partitions
  - On-demand downloads available to Center Site Account Managers

HPCMP Allocation Management Process

- **Allocate 100% of all resources at DoD Supercomputing Resource Centers**

- **Approximately 70% allocated to Services/Agencies for distribution**
  - Resources are delegated to the Services/Agencies for allocation to Service/Agency mission priorities
    - 30/30/30/10 (Army/Navy/Air Force/Agencies) split
  - Mechanisms in place to support Service/Agency allocations for high priority, advance reservations, and dedicated workloads

- **Frontier plus Challenge plus Service/Agency High-Priority is targeted at 35% of all resources allocated**
  - Challenge Projects will end in FY 2015
  - FY 2016 target is for Service/Agency High-Priority and Frontier to share the 35% pool
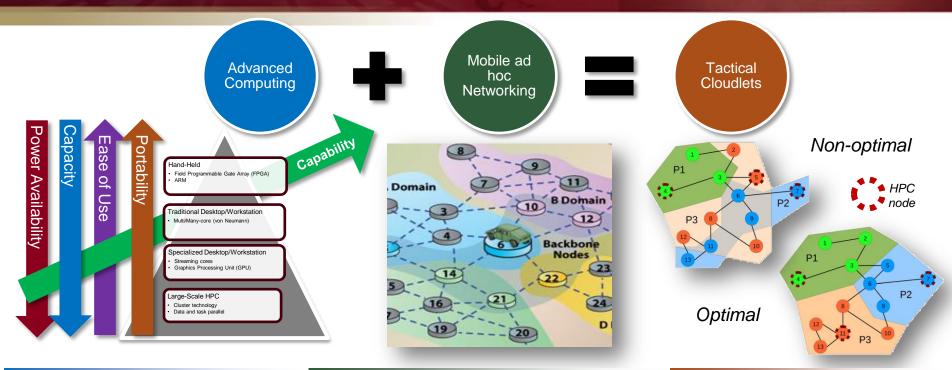
HPC Systems Performance Metrics

- **HPC Systems Performance Metrics are aggregated across all Program systems and sent to the HPC community monthly**

- **High-level metrics include:**
  - System usage
  - Turnaround time (expansion factor)
  - Value metric combines system usage and turnaround time into one overall metric which characterizes the total value of the computational time to the user community

- **New metrics being developed to track use and efficiency of advance reservation service**

US ARMY RDECOM

ARL

Advanced Computing **+** Mobile ad hoc Networking **=** Tactical Cloudlets

Power Availability | **Capacity** | **Ease of Use** | **Portability**

Capability

Hand-Held
- Field Programmable Gate Array (FPGA)
- ARM

Traditional Desktop/Workstation
- Multi/Many-core (von Neumann)

Specialized Desktop/Workstation
- Streaming cores
- Graphics Processing Unit (GPU)

Large-Scale HPC
- Cluster technology
- Data and task parallel

A Domain — **B Domain** — **Backbone Nodes** — **D**

Non-optimal

HPC node

Optimal

P1 · P2 · P3

- Focus on performance tailored per core
- No wasted processing cycles
- Power-aware and power-efficient
- Packing High Performance Computing (HPC) in small footprints

- Heterogeneous devices (and links)
- Hostile environments (short term, mobile, limited bandwidth)
- Cloud services too costly
- Virtually impossible to acquire real-time processing (via HPC)

- Efficiently distributed HPC nodes (seeding)
- Balanced processing capacity with demand
- Limiting hop distance between client-server

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.